In the interest of transparency, the following memo is being made available to the public, as well as the Department of Energy's official statement regarding the memo.

"The Energy Department is currently reviewing the memo sent by Gary Brunson. We recognize there are significant technical challenges remaining at the Waste Treatment Plant, some of which have existed for many years. The Department takes seriously its role overseeing the safe design and delivery of the Waste Treatment Plant, and is continuing to work with Bechtel to address the ongoing technical issues. Even as we work together to pursue solutions, however, the Department continues to be frustrated with the lack of progress. Addressing these challenges effectively will require both additional work by the contractor, as well as improved oversight by the Department. It's also important to note that the successful completion of this important project depends on employees continuing to be able to freely raise concerns."

RL-675 (03/99)

United States Government **Department of Energy**

Office of River Protection

memorandum

DATE: AUG 2 3 2012

REPLY TO ATTN OF: WTP:GEB 12-WTP-0274

SUBJECT: **Summary of Actions and Design Outcomes that Erode Confidence in the ability of Bechtel National Inc. to complete their assigned role as Design Authority for the WTP**

TO: Scott L. Samuelson, Manager,
Office of River Protection/Acting Federal Project Director for the Waste Treatment and Immobilization Plant

Delmar L. Noyes, Deputy Federal Project Director,
Waste Treatment and Immobilization Plant

This memorandum documents 34 instances and technical issues in which Bechtel National Inc., acting as Design Authority for the Waste Treatment and Immobilization Plan (WTP) has provided design solutions and technical advice to the Department of Energy which either:

- was determined to be factually incorrect,
- provided a design solution that was not technically defensible, technically viable, or was technically flawed considering identified requirements,
- provided a design solution that was not safe for the WTP operators, or designs that did not comply with the safety basis,
- provided a design solution that represented higher River Protection Project life cycle operating costs compared to other alternatives,
- provided a design solution that was difficult and costly to verify considering other alternatives, thereby increasing WTP completion costs and extending the WTP completion schedule,
- provided a design that was new and unique and does not clearly provide benefits compared to existing technologies and which required special qualification testing,
- provided an installed equipment system that did not meet safety requirements or was not adequately inspected following installation even when defects became known, or
- did not represent best value to the Government in terms of design costs, operating costs, or completion schedule.

These technical issues have occurred over the life of the WTP Contract. They illustrate the general behavior and performance of the BNI Engineering Organization acting as the WTP Design Authority and Design Agent.

The definition of the Design Authority is provided in the Engineering Department procedure. "Design Authority and Design Agency," 24590-WTP-3DP-G04T-00912. This procedure defines Design Authority as:

> *The organization (person or group) responsible for establishing and approving the design basis; and for ensuring that the design (including changes to the design and disposition of design basis affecting nonconformance, deficiencies, and deviations) conforms to the design basis and meets applicable codes and standards.*
> NOTE: This responsibility applies whether design is conducted fully in-house, partially contracted to outside organizations, or fully contracted to outside organizations.

Section 3.1 of 24590-WTP-3DP-G04T-00912 defines the responsibilities of the Design Authority as:

- *Establishing the design requirements, including those in the 24590-WTP-DB-ENG-01-001, Basis of Design, and those derived from the Contract and approved deliverables and work products such as the Authorization Basis (see 24590-WTP-GPP-SREG-002, E&NS Screening and Authorization Basis Maintenance).*
- *Ensuring that the design requirements and design basis are fully identified and maintained in a form compatible with needs (see 24590-WTP-RPT-ENG-01-001, Technical Baseline Description).*
- *Ensuring that design documents appropriately and accurately reflect the design basis, and that the project facilities are designed, procured, and constructed in a safe, reliable, and efficient manner in accordance with policies and all applicable laws, regulations, the Authorization Basis, and technical requirements.*
- *Design control and technical adequacy of the design process. This includes developing, approving, and maintaining procedures for conducting Design Authority and Design Agency activities.*
- *Implementing appropriate corrective actions, up to and including cessation of work, when technical work is not within procedural requirements.*

The technical issues described in the attachment demonstrate consistent non-compliance between requirements and selected designs implemented in the field, and between design of and realization of a safe operating facility. Repair and rework of these non-compliant designs are leading to significant project cost and schedule impacts. It has been separately disclosed that the

Pretreatment and HLW Vitrification facility designs are not in compliance with the Authorization Basis. A plan to bring the design and authorization basis in alignment is due to DOE in September 2012. The number and significance of these issues indicate that Bechtel National Inc. is not competent to complete their role as the Design Authority for the WTP, and it is questionable that BNI can provide a contract-compliant design as Design Agent.

Bechtel National Inc., has established an engineering team within the Vessel Completion Team (VCT) to resolve the technical issues associated with mixing in the PJM vessels. Bechtel Engineering and the Advanced Simulation and Analysis group have established a strategy for completing design verification of the PJM vessels. This strategy is based on an approach to use Computational Fluid Dynamics for verifying the design of the Newtonian PJM mixed vessels and full scale testing of the vessels designated as Non-Newtonian. Currently this strategy has many issues that have been independently identified by DOE, their independent subcontractor the National Energy Technology Laboratory (NETL) and the Defense Nuclear Facilities Safety Board. At this time it does not appear that CFD will be useful as a design verification tool for vessels that contain appreciable solids concentrations (e.g. > 5 wt%) based on these reviews. BNI Engineering has not developed a technically adequate and complete plan to resolve the vessel mixing issues, including a contingency plan due to the high risks associated with design verification.

The issues identified in the attachment were preceded by similar findings and concerns. Specifically, letters 02-OSR-0480, *Notification of Construction Authorization Readiness Assessment and Associated Concerns*, October 4, 2002, and 02-OSR-0530, *Inspection Report IR-02-015 – Design Process Inspection*, November 21, 2002, document findings associated with Quality Assurance and BNI's design process. That similar issues continue today is objective evidence of a complacent and ineffective Design Agent and Design Authority.

In addition, 5 Level 1 Findings have been issued over the past year starting in October, 2011. BNI still has not produced a root cause analysis/common cause analysis and corrective action plan, for any of the Level 1 Findings, acceptable to the Department.

The behavior and performance of Bechtel Engineering places unnecessarily high risk that the WTP design will not be effectively completed, resulting in fully operational facilities that are needed to comply with Contract requirements. Thus a change in approach to WTP project completion is warranted. The following recommendations are made based on my review of past, present, and future expectations for BNI Engineering performance.

1. The role of the WTP Design Authority should be immediately removed from BNI. The DOE should evaluate and select a preferred option to establish an Independent Design Authority for the WTP that will represent the interests of the DOE and the DOE operator. In addition, DOE should identify an independent operating contractor with approval authority for design and system turnover, consistent with other successful DOE projects.

2. DOE should retain the services of NETL to complete a feasibility study for the application of CFD to the verification of the PJM vessel designs for mixing. DOE and NETL should direct the required testing at the Mid-Columbia Engineering and the Energy Solutions testing facilities via the BNI VCT team to evaluate the feasibility of verification and validation of CFD for what will be its first-time Departmental use in support of nuclear design verification.

3. DOE should independently assess the strategies proposed by the BNI Engineering to complete vessel design verification. These strategies include: 1) the use of CFD, 2) engineering scaling, and 3) full scale testing of a prototype or the actual vessel. These strategies should be defined and characterized. Cost and schedule of these strategies should be estimated. A recommendation of the preferred strategy or combination of strategies should be made based on: cost, schedule to complete, and schedule for completion of the WTP design and commissioning of the WTP. The study should consider; vessels already installed and those vessels that remain to be installed including the mixing performance risk associated with each vessel design.

4. DOE management should always seek Federal engineering staff counsel and advice for design, construction, and commissioning issue resolution in advance of, and in preference to, the WTP Contractor and the Design Authority. (Unlike the contractor, Federal staff have no other motive than to represent the interests of the Department and the taxpayer.)

Gary Brunson
WTP Engineering Division Director
Waste Treatment and Immobilization Plant

cc: Mark C. Appleton
Richard H. Lagdon, Jr.
Matthew B. Moury
Steven C. Simonson
Steven Stokes

Attachment
12-WTP-0274

Examples of Counsel from the WTP Contractor as Design Authority

August 23, 2012

BNI provides advice to DOE as the Design Authority for WTP. The value of BNI's advice to the government has been questioned repeatedly since WTP contract inception. For example, a DOE Design Oversight from 2004 (04-WEC-005) concluded (p 97) that "no specific design margin is identified in the design basis documentation; however, the facility design basis is for a 40-year operating life." This conclusion was followed in 2012 with Priority Level 1 findings: that WTP lacks a required margin management program and there is a cumulative management breakdown (12-WTP-0111). A subsequent assessment found a demonstrated lack of compliance with Contract requirements in vendor submittals to WTP. This assessment identified one Priority Level 1 finding and four Priority Level 2 findings (12-WTP-0217.) Below are 34 examples, including recent advice, provided by BNI as Design Authority, and the consequences to the government.

DOE Engineering Staff have uncovered findings at a nearly constant rate since 2008. The rate of identification is constant, indicating systemic problems in the WTP design process and in BNI's role as Design Authority. The number and rate of problems identified is indicative that issues are not being resolved.

The issues identified below were preceded by similar findings and concerns, identified in letters 02-OSR-0480, *Notification of Construction Authorization Readiness Assessment and Associated Concerns*, October 4, 2002, and 02-OSR-0530, *Inspection Report IR-02-015 – Design Process Inspection,* November 21, 2002. These letters document findings associated with Quality Assurance and BNI's design process.

Brief Examples:

1. **LAW Off-Gas: BNI advice - *Off-gas should be under positive pressure***
   BNI designed the process offgas from the LAW vitrification system melters so that high concentrations of NOx gases were under positive pressure. Any pinhole leak would result in fatal concentrations in a matter of seconds in an area occupied by people. BNI claimed they could manage/seal 560 leak paths. Normal ALARA practice in the nuclear industry is that all such ventilation systems are operated at a negative pressure (vacuum) with respect to occupied areas. BNI downplayed this aspect by calling it a "pressure boundary," so the positive pressure configuration wasn't prominently known. BNI asserted that no fans existed that could perform this function. A DOE summer intern

located and provided sizing information for effective blowers. Vacuum was restored to most of the system as a result of sustained evaluation by DOE Waste Treatment Plant Engineering Division (WED) personnel.

Supporting Data: DOE-WED performed an assessment in April of 2009 (A-09-AMWTP-RPT-004). The technical Issues cut sheet that shows resolution of the issue by moving the fan was issue number 2009-0002, retired in January 2010. ORP requested this cut sheet beginning in December of 2008.

2. **Reboilers: BNI Advice - *Steam condensate should have a single loop. A contamination path to Balance of Facilities (BOF) is acceptable***

BNI designed the return line for steam condensate to the balance of facilities so that it came directly from use in Pretreatment Facility Reboilers, which are used to heat contaminated fluids. A pinhole lead in a reboiler tube could result in contaminated condensate being returned to the non-radiological Balance of Facilities equipment and occupied areas. Installed instrumentation would not prevent the spread of contamination if this occurred. Normal ALARA practice for potentially contaminated streams is to have a secondary closed loop system. A secondary steam loop was incorporated into the design as a result of sustained evaluation by WED.

Supporting Data: The issue dates to 2008 in 24590-WTP-CRPT-QA-08-545-B. A re-design was identified in the technical issues cut sheet from March of 2010, 2009-0006. The CRPT was closed in April of 2012.

3. **Preventing Precipitation in Ion Exchange Feed: BNI Advice - *Use the Heat/Dilute Option and not the Equipment Option***

BNI was responsible for preventing precipitation of solids in ion exchange feeds so that particles would not plug the ion exchange media. The solution recommended by BNI was to heat and dilute the waste, an approach that minimized the impact to BNI's management reserve funds, but was not in the best interest of the taxpayer. BNI's recommendation letter acknowledged that the option they recommended would be detrimental in terms of WTP mission duration, number of HLW and LAW glass canisters produced, and sodium added to the waste. DOE formally directed BNI to implement an equipment option, which provided the improved results. This was as a result of sustained WED review.

Supporting Data: In August of 2008, DOE requested an extent of condition by the design authority to include the ability of CXP-VSL-00001 design to mitigate the potential for

precipitated solids, or transfer of precipitated solids in upset conditions (08-ENS-007). The issue was resolved by re-design at the direction of DOE, per letter 10-WTP-076.

4. **Cathodic Protection: BNI Advice – *The Cathodic Protection system is operable***

BNI was responsible for design and turnover of the cathodic protection system to protect buried piping from corrosion. BNI made numerous claims that the system was operable, but WED reviews showed that it was not operating properly within the Washington Administrative Code (WAC)/NACE criteria, and had been altered in the field without compliance with design change processes. Years have passed and the system is not balanced or operating correctly as designed. Underground piping is at risk, may have become damaged, and may require replacement.

Supporting Data: In April of 2009, DOE identified, with findings, that BNI had deleted acceptance criteria for the cathodic protection system, and concluded that it was unclear whether the system would perform its intended function (09-WTP-078). Subsequent DOE reviews and surveillances uncovered additional problems and findings (10-WTP-110, 11-WTP-026, 12-WTP-0018). BNI's inability to determine a cause for the problems was identified in CCN: 233079. In July 2012, BNI received information from an external review that concludes that: design calculations were not conservative, anode configuration is not appropriate, and there is insufficient data to verify the integrity of the buried pipeline systems (CCN: 250397). This was directly counter to advice BNI gave to DOE in CCN: 240103, in December 2011, that the piping was being protected.

5. **Newtonian versus Non-Newtonian Fluids: BNI Advice – *Newtonian Fluid Properties bound the properties for Non-Newtonian Fluids and this is a valid assumption, not requiring verification***

BNI advised that Non-Newtonian vessels could be verified using only Newtonian Fluids because the BNI assumption that Newtonian fluid properties bound the properties for non-Newtonian fluids was a valid assumption, not requiring verification. Following concerted comments by WED, BNI tested this assumption, and found it was not valid. The project lost about 18 months because BNI delayed testing the assumptions. That the assumption was made at all was not in the interests of the government, because the differences between Newtonian and Non-Newtonian fluids are recognized.

Supporting Data: In April of 2010, DOE staff recommended testing Non-Newtonian vessels with non-Newtonian Slurries, prior to closure of the External Flowsheet Review Team (EFRT) M3 Mixing Issue. This testing was not conducted, and BNI asserted (24590-WTP-RPT-ENG-11-001) that Newtonian techniques associated with computational fluid

dynamics were sufficient to evaluate non-Newtonian slurries. DOE comments on the "Determination that Non-Newtonian Vessels can be Evaluated using Newtonian Techniques" included a request for a test. BNI asserted such a test was not necessary. BNI's delays associated with testing an unverified assumption were costly to the government. When the test report was published, it disproved the assumption and the Newtonian Methods report was cancelled in May of 2012.

6. **Flow Sheet Design Basis Mass Balance: BNI Advice – *Sr/TRU precipitation unit operation is not needed in the design basis mass balance, and it isn't a priority***

BNI did not include all Contract required unit operations in the design basis mass balance. As a result, the compositions in LAW vitrification were not checked to see that they met safety or disposal criteria. BNI then used the data to suggest increasing the Hazard Category for the facility, but there were errors due to the omitted step and lack of QA check on the product. When questioned, BNI said the contract didn't require them to include all unit operations, and a correction wasn't a priority. This resulted in a considerable waste of time and effort. The flowsheet error was discovered as the result of evaluations by WED in concert with DOE Nuclear Safety. Nuclear safety subsequently found further misuses of the flow sheet data.

Supporting Data: Emailed comments: Comments from DOE indicated errors in the hazard categorization. DOE Nuclear Safety's subsequent evaluation showed an overreach in applying DOE information. BNI defended the errors, claiming that the contract did not require the design basis mass balance to include all of the unit operations.

7. **Garnet/Olivine Additions: BNI Advice – *Aggressive abrasives can be added to the WTP feed and are acceptable to WTP equipment and operations***

BNI supported the tank farm contractor in suggesting that use of aggressive abrasives to cut holes in storage tanks for new risers would be acceptable. WED evaluations show this represents an unevaluated risk to WTP equipment and operations at a time when the design margin is not known and the WTP wear equation has been exceeded by test data. Impacts to pumps, valves, seals, and filtration were not quantified. The impact of stratified mixing was not quantified. The recommendation was based on opinion without objective evidence and on averaging properties, which is not recommended. Contrary to the recommendation, best industry practice recommends testing.

Supporting Data: Unresolved comments on the past addition of abrasive garnet to the tank waste date to 2010 and are located in 10-WTP-268. On May 18, 2012, DOE WTP Engineering provided a perspective on further additions of abrasives that was rejected, as

evidenced by the One-System recommendation to use olivine as a second abrasive in RPP-RPT-52779. DOE comments (12-TF-0032) on this report show that it does not provide data needed to underpin acceptance of aggressive abrasive. Unresolved responses to DOE comments (WRPS-1202054-OS) do not correct the issues, instead they concede missing data and reiterate opinions without data, and identify approval by BNI's design authority.

8. **Ion Exchange Sample Capability: BNI Advice – *Remove sample capability from the bottom of the ion exchange columns***

BNI as design authority removed sampling capability from the outlet streams that exit the bottom of the WTP ion exchange columns. That samples can be taken from the bottom of ion exchange columns is standard practice across the nuclear industry, and allows calculation of the decontamination factors across the columns. WED is unaware of any operating facilities that do not have this capability. However, because it was not a requirement, BNI removed the capability from WTP. The ability to evaluate column operations and to troubleshoot potential problems is limited when samples cannot be taken from the bottom of a column. The loss of flexibility is not in the best interests of the government.

Supporting Data: Sampler removal was supported by a BNI analysis presented in meeting notes per CCN 206454, which was prepared in response to DOE concerns. Subsequent problems are documented in an email transmittal.

9. **Computational Fluid Dynamics (CFD): BNI Advice: *CFD can be used for design verification for multi-particle applications in WTP Pulse-Jet Mixed Vessels***

BNI recommended use of computational fluid dynamics modeling using the FLUENT code for performing design verification of WTP Vessels. BNI's previous similar application of this code was only for water – on the Tacoma Narrows Bridge. BNI's application is contrary to the approach recommended by mixing consultants in August of 2008, which was to use CFD to eliminate obvious poor choices – using it to limit the extent of testing. At present, the National Engineering Technology Laboratory (NETL), the Defense Nuclear Facilities Safety Board (DNFSB), and WED have unresolved comments on the determination of precision and accuracy for use of CFD to underpin design. The expense and feasibility to acquire and apply CFD has been significant with no value yet obtained for verification of the design, and no understanding of its application for nuclear design verification.

Supporting Data: Input from the National Energy Technology Laboratory indicates (email)

that BNI discussions and presentations did not "provide confidence in BNI's ability to use CFD." This is in spite of years of government expense to purchase software and develop BNI's models and capability. Follow up information (08-15-12 email) indicates that "BNI has not exercised their FLUENT model adequately to even answer basic questions about sensitivity, grid resolution, and computational effort really was an eye opener for my team. This information is basic information any experienced CFD user would be able to address prior to any informational testing and simulation period and if an organization was getting ready to use this model for "prime time" applications. The fact that BNI was unable to really address these points really causes concern for me and my team." NETL comments on BNI's work to respond to the DNFSB on this topic are documented in a letter that notes BNI's contentious approach.

10. **LAW Vitrification Hazard Category: BNI Advice – *Use plant feed acceptance criteria limits for evaluating the LAW facility***

BNI used "material at risk" dose concentration limits that were approved only for severity level analysis, and valid only for the feed to WTP and in Pretreatment, for evaluating the LAW vitrification hazard categorization. The values for feed concentration exceeded the safety acceptance limit for the LAW facility, so the results were not useful (increase to the category without a sound basis). That the error wasn't caught is shown in item 6, above. BNI asserted that the change makes no difference. BNI's implication was that their poor performance was therefore excused. However, DOE Nuclear Safety has identified changes that may be needed, and therefore costs to the government, as a result of the proposed change to a more challenging category. This error was identified through the coordinated efforts of WED and DOE Nuclear Safety.

Supporting Data: DOE Nuclear Safety perspective is summarized in a July 19, 2012 email.

11. **Gas Turbine Generators: BNI Advice – *Gas Powered Turbine Generators can be used instead of Diesel for Nuclear Emergency Power Application***

BNI has recommended using gas powered turbine generators for emergency power, to replace the previously specified diesel generators. This recommendation replaced diesel technology that had known nuclear applications, with an unproved application that required evaluation and rework. Turbine generators have a longer start time, requiring re-evaluation of safety scenarios, at additional cost to the government. The vendor was not NQA-1 qualified, and was not qualified to perform the requisite seismic evaluation. Additional quality assurance work is therefore needed at government expense.

Supporting Data: Deficiencies were identified in August 2011 DOE comments (email).

Additional costs are incurred in updating the procurement to include quality specifications per a change and the specification document.

12. **Defects in Buried Piping: BNI Advice – *No extent of condition is needed to evaluate pitted ammonia line piping***

BNI previously found corrosion in buried piping. Results of previous evaluations included identification of two minimum wall violations, and 9 of 11 sites checked having coating defects (called "holidays"). In spite of this previous experience, BNI recommended no extent of condition review when additional corrosion was found in buried important-to-safety ammonia piping. The recommendation to the government was not to look further. WED evaluation shows that an extent of condition is warranted.

References: BNI's nonconformance report is 24590-WTP-NCR-CON-11-0353. DOE identified inadequate assurance by the design authority and requested an extent of condition in 12-WTP-0043.

13. **Mixing Design Basis: BNI Advice – *Mixing systems should be designed based on average or restricted slurry properties***

BNI's design for mixing systems used average properties and did not account for the increase in proportion of dense particles that occurs during the aluminum leaching step. In 2006, this was pointed out by the Expert Flowsheet Review Team (EFRT). BNI's response was to advocate for the least challenging increase to particle size distribution and for a small increase in density. WED prepared analyses of particle size distributions and density increases in order to negotiate more defensible, challenging conditions. BNI did not look proactively at the data for challenging conditions. The change would not have occurred in the absence of WED analyses and identification of objective evidence. Particle sizes of ~300 microns were increased to ~700 microns on receipt of WED particle size distribution analysis.

Supporting Data: The EFRT Report was published in 2006. DOE provided objective evidence in comments for both particle size distributions and large particle density.

14. **HEPA Filter Loading: BNI Advice: *There's no need to test the filters***

BNI selected first of a kind US radial HEPA filters for use in WTP. The conceptual design was based on a different (British) vendor's filters. BNI made an assumption requiring verification that loading data from the British vendor's filters was applicable to the new US design. The assumption was made in spite of potential problem conditions identified in the calculation. BNI initially planned to verify the assumption with testing, but later

recommended that no testing was needed, and instead would apply margin. WED concerted review resulted in tests conducted by DOE on the US filters, which failed the loading tests and require rework.

References: The assumption requiring verification is located in 24590-WTP-MAC-M72T-00001. The DOE Sponsored test report is located in 12-WTP-0035, which is a sensitive document. The report includes DOE's test plan. Results of DOE sponsored tests are summarized in a presentation.

15. **Materials Selection: BNI Advice – *304-L and 316-L stainless steels are robust enough for 40 year life at elevated leaching temperatures in the presence of caustic, chloride, fluoride, mercury, and permanganate, without test results using the most challenging conditions***

BNI used a nominal simulant composition to underpin testing to verify material selection for vessels used in leaching aluminum. BNI did not resolve WED comments questioning the basis for the simulant. The simulant did not include species of concern, including permanganate and mercury. The testing was not conducted appropriately and the concentrations were not maintained at the planned levels. In spite of this BNI concluded that the materials selected were acceptable. Implementation of BNI's process for selecting materials for vessels was not supported by the literature cited, which included unavailable proprietary data. Additional tests are now needed.

Supporting Data: DOE identified deficiencies in BNI's corrosion tests in 11-WTP-258. BNI responded to the surveillance by issuing a second test report that altered and reduced BNI's rigor of the test objectives. DOE rejected BNI's response in 11-WTP-415. DOE identified deficiencies in BNI's selection of materials of construction for vessels in 11-WTP-357. BNI used references to establish temperature limits but did not provide an analysis of the literature conditions and their applicability to WTP conditions in 24590-WTP-RPT-M-04-0008, Table 5-1. Unavailable proprietary data from BNFL are cited in the same table. BNI's action plan for erosion-corrosion issues now shows a step for evaluating inputs from the literature against WTP operating conditions, a step which was identified by DOE and the DNFSB, not by the design authority.

16. **HLW Spent Melter Disposal: BNI Advice – *Melters can be disposed onsite as Remote Handled TRU waste***

BNI recommended disposing of HLW melters on-site as remote handled TRU. However, disposal of remote handled TRU is prohibited at Hanford. The design authority did not address interfacing disposal requirements. WED review showed this advice to be

unfeasible.

Supporting Data: BNI identified spent HLW melters as transuranic waste (TRU) on page C-46 of 24590-WTP-RPT-ENS-10-010. On page 16 of 24590-WTP-PL-RT-03-003, in spite of the prohibition, BNI stated that "for spent and failed melter disposal, a permitting and regulatory pathway is being evaluated to ensure that melter design, treatment, and classification provide a high level of confidence that necessary permits can be obtained and that the melters are classified such that Hanford Site disposal is possible." The recommendation does not comply with The Tank Waste Remediation System (TWRS) Environmental Impact Statement Summary, which states on page S-3 that transuranic (TRU) waste "cannot be disposed of in a near-surface facility."

17. **Melter Purge Vacuum System: BNI Advice – *HLW glass can be purged ahead of melter disposal by using a vacuum system***

BNI proposed a vacuum system, similar to one used at West Valley, to purge the glass from HLW melters. This was not a feasible alternative, because the melters are in an area that is sealed, and so the vacuum system could not physically be installed. In spite of the obvious lack of feasibility pointed out by WED, BNI proposed continued spending to evaluate this alternative.

Supporting Data: A photograph of the West Valley installation shows that the equipment is large and so can't be installed in a closed black cell in order to empty a melter.

18. **Sparger Plugging: BNI Advice – *Plugging can be mitigated with a manual wash and can be ignored in air entrainment calculations***

Despite prior known problems at Savannah River and West Valley, followed by problems observed in WTP aerosol testing, BNI assumed a water wash will unplug spargers that plug and BNI was not planning qualification tests to verify that they will operate properly under WTP chemistry conditions.

Supporting Data: BNI evaluation (CCN 239182) recommended that sparger wash down would mitigate the issue and prevention would be handled in vessel completion testing. However, vessel completion tests do not include chemical simulants at this time. Following comment from WTP Engineering, BNI cancelled CCN 239182, and published CCN 239183, which contains additional actions including evaluation of vessel conditions and integration with VCT tests.

19. **Hazards analysis and System Descriptions: BNI Advice – *Hazard Identification can be performed using "whatever" process information is available***

Following a WED surveillance that showed that BNI was not using system descriptions as required in Hazards analysis meetings, and that stressed the importance of the system descriptions, BNI eliminated the requirement. BNI's assertion in the governing procedure that "obviously, the more information and knowledge one has about a process, the more thorough and valuable the hazard identification can be" is inconsistent with the NQA-1 notion that procedures are used to provide a standard best practices method. The assertion indicates a lack of interest in uniform quality in hazards analysis.

Supporting Data: DOE prepared a closure surveillance to verify completion of the agreed corrective actions, and found that BNI did not perform the corrective action as agreed, and reduced a requirement in the governing procedure. The surveillance is currently in factual accuracy review.

20. **Decontamination Methods: BNI Advice – *CO_2 Pellet Blasting is a necessary and effective method for decontaminating LAW glass containers***

BNI as design authority included CO_2 pellet blasting as a means to decontaminate LAW glass containers. Introduction of high pressure CO_2 in the plant is a significant safety hazard to personnel. Transport of LAW containers is on-site at Hanford, and the source term is limited. Therefore containers can be transported without decontamination. This is documented according to an approved transport analysis. Including this equipment at the LAW facility is an unnecessary expense to the government and an unnecessary safety risk for employees.

Supporting Data: DOE Evaluation in 11-NSD-035 showed a lack of need for decontamination and use of stainless steel for LAW glass containers. In spite of the information provided, BNI retains both in the design.

21. **Technetium-99 Ion Exchange Capability: BNI Advice – *Ion Exchange for Tc-99 is not necessary***

In January of 2003, DOE approved a BNI trend to remove technetium ion exchange capability from the waste treatment plant. The associated documentation provided to the Department of Ecology in the permit modification request shows that mass balance information was used to underpin the distribution of technetium throughout the plant. The mass balance was based on unverified assumptions, and not on glass solubility data. One of the drivers for BNI's proposed trend was to reduce costs from their budget. The ion exchange resin had an increasingly high cost from a sole source vendor. As a result,

the distribution and management of technetium remains an issue, with conceptual designs requiring review at government expense. Risk to the government is mitigated in this area because of DOE sponsored development of improved HLW glass. Specifically - greater single pass technetium retention through low temperature formation of insoluble Tc salts that have no negative impact on glass production or performance.

Supporting Data: The permit modification request is documented in 04-ED-068. Use of decontamination factors for process modeling (instead of solubility data) is shown in the Flowsheet Basis Document, 24590-WTP-RPT-PT-02-005, pages 3.2-45 and 4.2-37. These values represent fixed percentages retained, so they are insensitive to the incoming concentrations, which can vary with accumulation in recycles, and insensitive to solubility in glass.

22. **Vessel Cooling Jackets and Margin: BNI Advice – *0.11 to 0.25 psi design margin is acceptable for cooling jackets in a black cell environment requiring 40 year operating life***

BNI designed vessels equipped with cooling jackets and established the internal design pressure at the conceptual design stage. BNI then established a margin requirement to be "the greater of either 10% of the operating pressure or 10 psi." BNI was shown that the actual margin was near zero. At about the same time, BNI reduced the design margin requirement to the minimum, which was to meet code and invoke the exceptions/allowances methods in the code. (Codes are clearly marked that they are not design guides.) Subsequent analysis shows that the bottom heads of three vessels are vulnerable to buckling.

Supporting Data: DOE expressed a continuing concern in 10-WTP-240. BNI provided a response in CCN 227137. The response does not include safety margin or integration with subsequent buckling issues. BNI has not provided a formal analysis of design and safety margins for vessels with cooling jackets in spite of repeated DOE requests dating back more than a year. Cooling Jacket margin was associated with a Level 1 finding. BNI's response in CCN 236405, to the recent series of Priority Level 1 Findings, including for design and safety margin, has not been accepted and DOE is in the process of writing a reply/rejection.

23. **Nationally Recognized Testing Laboratory Label (NRTL) Exemption: BNI Advice – *Equipment under 50 volts is exempt from NRTL labeling requirements***

BNI, acting as electrical authority having jurisdiction (AHJ), waived NFPA-70 contract requirements without providing proper justification, evaluation, and alternative methods

of achieving equivalent safety. BNI's AHJ decision provided the WTP Project blanket approval to waive NFPA-70 labeling requirements for 50 volt or less equipment and devices. This advice was not in compliance with the electrical code, which required that all electrical conductors and equipment be labeled, and allowing alternatives only after specific case interpretation. As a result, non-compliant equipment has been installed.

Supporting Data: This issue was identified by surveillance in 11-WTP-222. Continuation of this issue and lack of adequate response is documented in 11-WTP-398.

24. **Uninterruptible Power Supplies: BNI Advice – *Canadian labeling standards are acceptable for WTP***

BNI did not meet requirements for certification by a Nationally Recognized Testing Laboratory when they accepted procured uninterruptible power supply (UPS) equipment (battery back-up power). Specified conditions of acceptance require that plant equipment be appropriately listed or labeled by an NRTL. Uninterruptible power supply equipment was certified against a Canadian standard but not against a U.S. standard. The US indicator is required.

Supporting Data: The associated surveillance is located in 09-WTP-103.

25. **Ammonia Dilution Skids: BNI Advice – *Ammonia Dilution Skids should be installed indoors***

BNI designed ammonia supplies to LAW and HLW vitrification off-gas selective catalytic reduction equipment so that leaks from pressurized piping are estimated to result in fatal concentrations within 14 and 38 seconds, respectively. Operations recommendations from safety meetings, to provide a ventilation enclosure or relocate the equipment outdoors, and dating from 2008, were not acted on. The HLW ammonia system is adjacent to a control room. Standard industrial practice is to locate this equipment outdoors, and at a downwind location, as was done for previous Hanford processes. BNI's advice was that the control system would be adequate to protect personnel.

Supporting Data: DOE issued a surveillance of ammonia leak consequences, with associated findings, under cover letter 12-WTP-0256.

26. **Isolok Sampling System: BNI Advice – *The sampling system has been demonstrated to meet performance criteria***

BNI closed a sampling issue identified by the External Process Flowsheet Review Team (EFRT) without meeting the performance criteria, and using data/criteria that were revised after testing was complete. The EFRT report stated that "The ability of the sampling system to provide representative samples is absolutely essential for process control." Criteria were not met because testing identified analytical uncertainty errors for minor components important to melter operations, and also identified that unresolved biases and uncertainties in the sampling and analytical results for minor components used in simulant testing were greater than the specified acceptance criteria. In addition, BNI never completed the follow on action after 1 year as promised. The commitment due date was extended to beyond 2013 without notification to federal staff. The test results indicate that there is a risk that the uncertainty in mixing, sampling, and analysis will lead to reduced LAW and HLW waste loadings, and therefore increased volumes of LAW and HLW glass that will not comply with WTP Contract waste loading requirements. DOE requested a technical issue cut sheet for sampler functionality and operability in March 2009.

Supporting Data: The closure record with follow on action is located in CCN 184906. The technical issues cut sheet was closed with a commitment to finish incomplete remaining actions. In addition, DOE is in the process of issuing a surveillance on sampling capability, to be issued per letter 12-WTP-00250.

27. **Conservatism in Feeds for Process Corrosion Data Sheets: BNI Advice - 1 mole Aluminum complexes 3 moles of fluoride to protect against corrosion**

BNI provided a white paper design input analysis to demonstrate conservatisms in the feed composition chosen for process corrosion data sheets. The analysis made an unsupported claim that 1 mole of aluminum is sufficient to complex 3 moles of fluoride, resulting in protection from corrosion. DOE evaluation showed this assumption to be contradicted by testing at Savannah River with corrosion increasing exponentially at a 1:3 ratio of aluminum to fluoride. DOE evaluation also showed that previous processes at the Hanford Purex Plant added aluminum at a ratio of 3:1 to fluoride and still experienced stainless steel vessel failures.

Supporting Data: DOE prepared a draft surveillance, in process. BNI provided supporting information about the extent of the feed vector, and claimed in a discussion meeting that the Bayer Process was the basis for the unverified assumption that 1 mole of aluminum complexes 3 moles of fluoride. When asked for the reference, BNI admitted in an email

that the Bayer Process was not the source of the assumption, and that predicting speciation "is a challenge."

28. **Process Control of Pulse Jet Mixed Vessels: BNI Advice - Bubblers should be raised above the bottom of vessels**

BNI recommended raising the bubblers, which measure level and density, 12 to 16 inches above the bottom of 17 pulse jet mixed vessels in pretreatment, based on an unverified expectation of plugging. No analysis was provided to evaluate the impact to process control. Raising the bubblers results in the inability to determine the mass of material below the bubblers, including potentially accumulating solids. The change also results in the inability to know accurately the overall average density of the slurry in the tank. Requests by DOE dating from April 30, 2012 for information and documentation of safety review have gone unanswered.

Supporting Data: BNI's recommendation is located in CCN 213921. Implementation of the change in a drawing is shown in detail 6 of 24590-PTF-MV-HLP-00003004.

29. **Closure Method for LAW Glass Containers: BNI Advice – Use a Mechanical Seal**

BNI recommended using mechanical seals to close LAW Glass containers instead of welding. BNI established welded closure for HLW canisters, but changed to a different technology for closing LAW containers, involving a spring gasket. The advantage to the government of having a single technology to verify and operate was not realized. DOE had to issue a letter of direction to the design authority to improve the readiness of the selected system. BNI has a leak test requirement (based on a welded container, per the WTP contract). When testing of the mechanical seal was initiated, the certified tester asked why he was being directed to use the wrong ASTM method. The test results were unacceptable, and BNI wrote an internal white paper explaining why this was ok. Testing of the method resulted in a high failure rate, an indication that the technology is not robust. BNI asserted that flaws in the manufacturing process were responsible. The manufacturing errors were corrected, but BNI has not tested the updated system.

Supporting Data: DOE's letter of direction was issued in March of 2007, 07-WTP-061. DOE then requested a technical issues cut sheet for this topic (first request) in December of 2008. BNI asserted in CCN 190898 that there is no seal requirement, which is contrary to the WTP contract. DOE issued a surveillance of the LAW lidding seal leak testing in May of 2009, including observations transmitted with letter 09-WTP-077. BNI attempted to justify use of an incorrect test method in CCN 198423. BNI's response in CCN-198907 was to initiate a risk. BNI also failed to show that the seal remained intact after loading,

according to a DOE surveillance transmitted with letter 09-WTP-087. In 2010, DOE continued to provide comments regarding the test results.

30. **PJM-Mixed Vessels: BNI Advice – Use a Custom Design for Each Application**
BNI as design authority established 22 different sizes/configurations for WTP pulse jet mixed vessels. This advice is not in the best interest of the government because it results in multiple design verification efforts. Verifying a single or limited number of designs would result in far lower costs. The design authority was not forward looking to determine the consequences of using custom designs. The result is additional cost and an increased risk that vessels will not support the design life. Previous Hanford process plants used standard vessel designs.

Supporting Data: BNI's 22 vessel types are shown in a diagram.

31. **Design Concept: BNI Advice – Retain Black Cell Concept**
The WTP contract acknowledged that the WTP Conceptual Design provided a reference solution that appeared to meet project requirements, but noted that the conceptual design had significant potential for optimization. BNI as design authority did not question the black cell concept, although it led to the use of pulse jet mixers instead of mechanically mixed tanks. Mechanically mixed tanks benefit from worldwide test and experience data. In contrast, pulse jet mixed vessels had limited application, and no application that was consistent with the slurry properties in the WTP. Use of the black cell and PJM approach complicates the design verification process and reduces flexibility compared to a canyon building design, with which Hanford has had four generations of experience.

Supporting Data: A review of WTP processes in 2001 expressed concern that "the almost complete dependence on fluidics for mixing, sampling, and transporting solutions and slurries is considered to be non-conservative. The team is unaware of data and experience that would justify an assumed 40-year lifetime when used with basic high solids materials. The concerns include both issues of plugging and of erosion and corrosion." This concern raises doubt regarding the value of recommending the black cell/40-year design life concept to the government.

32. **HLW Concentration: BNI Advice – Use Ultrafilters/Do not include Evaporation**
WTP is the only vitrification facility in the world that uses filtration as the sole method to concentrate solids ahead of a HLW melter. With use of a single, first of a kind application, there is a risk that the mission production rate will not be met.

33. **Material Balance: BNI Advice - Timely and Complete Updates aren't Needed**
BNI failed to maintain a current material balance in support of design. Existing corrosion evaluations in 2011 were based on a 2006 model called "WEBPPS," which could not be verified. The WEBPPS model was replaced with the APPS model in 2010. BNI did not make an effort to update the mass balance until DOE pointed out, in comments associated with DOE surveillances regarding material selection, and in addressing a differing professional opinion, that the corrosion evaluations were based on out of date information. An updated mass balance was not produced until April of 2012. It is under review for adequacy.

Supporting Data: BNI's initial action plan to address erosion-corrosion design issues, 24590-WTP-RPT-ENG-12-016, Rev 0, states that "calculations that contain unverified assumptions have been completed to support materials corrosion loss and erosion wear. General corrosion wear rates have been established based on unconfirmed mass balance information detailing tank waste chemistries. Work is underway to document design limits, expected operating limits and design margin for the vessel materials."

34. **Implementation of Black Cell Oversight Recommendations: BNI Advice – Timely Completions is not Needed**
BNI did not evaluate the impacts of waste leaching on the particle properties to be evaluated in design. In February 2004, DOE recommended that "BNI should determine if waste processing in WTP has the potential for increasing the erosion potential of the waste." Leaching, for example, preferentially removes aluminum (boehmite and gibbsite), leaving behind material that is more dense and likely harder/more abrasive. BNI did not evaluate this issue thoroughly and activities to complete an updated assessment of waste properties is in progress more than eight years later – in 2012.

Supporting Data: Design Oversight Report, Black Cell Adequacy, 04-WEC-005, contains the recommendation, on page 12.

Summary of Counsel from the WTP Contractor	
Item Number	**Title**
1	LAW Off-Gas: BNI advice - *Off-gas should be under positive pressure*
2	Reboilers: BNI Advice - *Steam condensate should have a single loop. A contamination path to BOF is acceptable*
3	Preventing Precipitation in Ion Exchange Feed: BNI Advice - *use the Heat/Dilute Option and not the Equipment Option*
4	Cathodic Protection: BNI Advice – *The cathodic protection System is operable*
5	Newtonian versus Non-Newtonian Fluids: BNI Advice – *Newtonian Fluid Properties bound the properties for Non-Newtonian Fluids and this is a valid assumption, not requiring verification*
6	Flow Sheet Design Basis Mass Balance: BNI Advice – *Sr/TRU precipitation unit operation is not needed in the design basis mass balance, and it isn't a priority*
7	Garnet/Olivine Additions: BNI Advice – *Aggressive abrasives can be added to the WTP feed and are acceptable to WTP equipment and operations*
8	Ion Exchange Sample Capability: BNI Advice – *Remove sample capability from the bottom of the ion exchange columns*
9	Computational Fluid Dynamics (CFD): BNI Advice: *CFD can be used for design verification for multi-particle applications in WTP Pulse-Jet Mixed Vessels*
10	LAW Vitrification Hazard Category: BNI Advice – *Use plant feed acceptance criteria limits for evaluating the LAW facility*
11	Gas Turbine Generators: BNI Advice – *Gas Powered Turbine Generators can be used instead of Diesel for Nuclear Emergency Power Application*
12	Defects in Buried Piping: BNI Advice – *No extent of condition is needed to evaluate pitted ammonia line piping*
13	Mixing Design Basis: BNI Advice – *Mixing systems should be designed based on average or restricted slurry properties*

Summary of Counsel from the WTP Contractor	
Item Number	**Title**
14	HEPA Filter Loading: BNI Advice: *There's no need to test the filters*
15	Materials Selection: BNI Advice – *304-L and 316-L stainless steels are robust enough for 40 year life at elevated leaching temperatures in the presence of caustic, chloride, fluoride, mercury, and permanganate, without test results using the most challenging conditions*
16	HLW Spent Melter Disposal: BNI Advice – *Melters can be disposed onsite as Remote Handled TRU waste*
17	Melter Purge Vacuum System: BNI Advice – *HLW glass can be purged ahead of melter disposal by using a vacuum system*
18	Sparger Plugging: BNI Advice – *Plugging can be mitigated with a manual wash and can be ignored in air entrainment calculations*
19	Hazards analysis and System Descriptions: BNI Advice – *Hazard Identification can be performed using whatever process information is available*
20	Decontamination Methods: BNI Advice – *CO_2 Pellet Blasting is a necessary and effective method for decontaminating LAW glass containers*
21	Technetium-99 Ion Exchange Capability: BNI Advice – *Ion Exchange for Tc-99 is not necessary*
22	Vessel Cooling Jackets and Margin: BNI Advice – *0.11 to 0.25 psi design margin is acceptable for cooling jackets in a black cell environment requiring 40 year operating life*
23	Nationally Recognized Testing Laboratory Label (NRTL) Exemption: BNI Advice – *Equipment under 50 volts is exempt from NRTL labeling requirements*
24	Uninterruptible Power Supplies: BNI Advice – *Canadian labeling standards are acceptable for WTP*
25	Ammonia Dilution Skids: BNI Advice – *Ammonia Dilution Skids should be installed indoors*
26	Isolok Sampling System: BNI Advice – *The sampling system has been demonstrated to meet performance criteria*
27	Conservatism in Feeds for Process Corrosion Data Sheets: BNI Advice - 1 mole Aluminum complexes 3 moles of fluoride to protect against corrosion.

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31	Design Concept: BNI Advice – Retain Black Cell Concept
32	HLW Concentration: BNI Advice – Use Ultrafilters/Do not include Evaporation
33	Material Balance: BNI Advice - Timely and Complete Updates aren't Needed
34	Implementation of Black Cell Oversight Recommendations: BNI Advice – Timely Completions is not Needed